What is claimed is:

1. A method of forming an oxide layer on a substrate surface comprising:

exposing the substrate surface to a precursor including an amino functional group to form a chemisorbed precursor layer on the substrate surface; and

oxidizing the chemisorbed precursor layer with an oxidant to form the oxide layer on the substrate surface.

2. A method of forming an oxide layer according to claim 1, wherein;

the precursor is represented by a chemical formula of MX_n,

with M representing one element selected from the group consisting of elements found in groups 2, 3A including lanthanide, 4A, 5A, 3B, 4B and 5B of the periodic table,

X representing $-NR_1R_2$ wherein R_1 and R_2 independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbon atoms,

and n represents the integer 2, 3, 4 or 5.

3. A method of forming an oxide layer according to claim 2, wherein:

M is an element selected from the group consisting of Sr, Ba, Y, La, Ti, Zr, Hf, V, Nb, Ta, Al, Ge, Pb, As, Sn, Si and Bi.

4. A method of forming an oxide layer according to claim 3, wherein:

M is hafnium.

5. A method of forming an oxide layer according to claim 1, wherein: the precursor is at least one selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$, $Hf[N(C_4H_9)_2]_4$, $Ti[N(CH_3)C_2H_5]_4$, $Zr[N(CH_3)C_2H_5]_4$, $Sn[N(CH_3)C_2H_5]_4$, $Si[N(CH_3)C_2H_5]_4$, $Ta[N(CH_3)C_2H_5]_5$, $Al[N(CH_3)C_2H_5]_3$ and $(CH_3)_2AlNH_2$.

6. A method of forming an oxide layer according to claim 1, wherein: the oxidant is at least one oxidant selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

7. A method of forming an oxide layer according to claim 6, wherein the oxidant is O_3.

8. A method of forming a thin oxide film on a semiconductor substrate comprising, in order:

(a) installing the semiconductor substrate within a chamber;

(b) introducing a volume of a precursor having an amino functional group into the chamber under conditions that will cause a portion of the precursor to chemisorb on the semiconductor substrate and form a precursor layer;

(c) removing from the chamber substantially all of the volume of the precursor that is not incorporated in the precursor layer;

(d) introducing a volume of an oxidant into the chamber;

(e) reacting a portion of the oxidant with the precursor layer to form an atomic thin film an oxide on the semiconductor substrate; and

(f) removing from the chamber an unreacted volume of the oxidant from the

chamber.

9. A method of forming a thin oxide film according to claim 8, wherein:

the precursor includes at least one material selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$ and $Hf[N(C_4H_9)_2]_4$.

10. A method of forming a thin oxide film according to claim 8, wherein:

the oxidant includes at least one oxidant selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

11. A method of forming an oxide thin film according to claim 10, wherein:

the oxidant is O_3.

12. A method of forming a thin oxide film according to claim 8, wherein:

the precursor is introduced into the chamber at a temperature not greater than about 300 °C. and under a pressure not greater than about 0.4 Torr,

the precursor being introduced into the chamber through the use an inert carrier gas.

13. A method of forming a thin oxide film according to claim 8, wherein:

steps (b) through (f) are repeated at least once.

14. A method of forming a thin oxide film according to claim 8, wherein:

removing from the chamber substantially all of the volume of the precursor that

is not incorporated in the precursor layer and removing the unreacted volume of the oxidant from the chamber includes introducing an inert gas into the chamber.

15. A method of forming a capacitor of a semiconductor device comprising:

(a) forming a first electrode on a semiconductor substrate;

(b) exposing the first electrode to a precursor containing an amino functional group to form a chemisorbed precursor layer on the first electrode;

(c) reacting the precursor layer with an oxidant to form an oxide dielectric layer on the first electrode; and

(d) forming a second electrode on the dielectric layer.

16. A method of forming a capacitor according to claim 15, wherein:

the precursor is at least one compound selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$, $Hf[N(C_4H_9)_2]_4$, $Ti[N(CH_3)C_2H_5]_4$, $Zr[N(CH_3)C_2H_5]_4$, $Sn[N(CH_3)C_2H_5]_4$, $Si[N(CH_3)C_2H_5]_4$, $Ta[N(CH_3)C_2H_5]_5$, $Al[N(CH_3)C_2H_5]_3$ and $(CH_3)_2AlNH_2$.

17. A method of forming a capacitor according to claim 15, wherein the oxidant is at least one oxidant selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

18. A method of forming a capacitor according to claim 15, wherein:

the first electrode has an aspect ratio of at least 10:1.

19. A method of forming a capacitor according to claim 15, wherein:

the first electrode includes a layer of at least one conductive material selected from the group consisting of doped polysilicon, metal nitrides and metals.

20. A method of forming a capacitor according to claim 19, wherein:

the first electrode includes a doped polysilicon layer and a nitride layer formed on a surface of the doped polysilicon layer.

21. A method of forming a capacitor according to claim 15, wherein:

the second electrode includes a layer of at least one conductive material selected from the group consisting of doped polysilicon, metal nitrides and metals.

22. A method of forming a capacitor of a semiconductor device comprising:

(a) forming a first electrode on a semiconductor substrate;

(b) exposing the first electrode to a first precursor containing an amino functional group to form a chemisorbed first precursor layer on the first electrode;

(c) reacting the first precursor layer with an oxidant to form a first oxide dielectric layer on the first electrode;

(d) exposing the first oxide dielectric layer to a second precursor containing an amino functional group to form a chemisorbed second precursor layer on the first electrode;

(e) reacting the second precursor layer with an oxidant to form a second oxide dielectric layer on the first electrode, the first and second oxide dielectric layers

cooperating to form a composite dielectric layer; and

(f) forming a second electrode on the composite dielectric layer.

23. A method of forming a capacitor according to claim 22, wherein:

the first and second metal oxide layers are different and are selected from a group consisting of HfO_2, ZrO_2, Ta_2O_5, Y_2O_3, Nb_2O_5, TiO_2, CeO_2, In_2O_3, RuO_2, MgO, SrO, B_2O_3, SiO_2, GeO_2, SnO_2, PbO, PbO_2, V_2O_3, La_2O_3, As_2O_5, As_2O_3, Pr_2O_3, Sb_2O_3, Sb_2O_5, CaO and P_2O_5.

24. A method of forming a capacitor according to claim 23, wherein:

the first and second metal oxide layers are Al_2O_3 and HfO_2.

25. A method of forming a capacitor on a semiconductor device comprising:

forming a first electrode;

forming an oxide layer according to claim 1; and

forming a second electrode.

26. A method of forming an oxide layer according to claim 1, wherein:

the precursor is represented by a chemical formula of MX_nY_m,

with M representing one element selected from the group consisting of elements found in groups 2, 3A including lanthanide, 4A, 5A, 3B, 4B and 5B of the periodic table that has an oxidation state S,

X representing $-NR_1R_2$ wherein R_1 and R_2 are independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbon atoms,

and n represents the integer 1, 2, 3, 4 or 5, and

Y is selected from a group consisting of hydrogen, alkyl groups having 1-4 carbons and amino functional groups $-NR_3R_4$ wherein R_3 and R_4 are independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbons,

and m represents the integer 0, 1, 2, 3 or 4, and

wherein m and n satisfy the equation (m+n)=S.